

Claims

- [c1] 1. A method for fabricating an array of biological probes, comprising the steps of:
providing a substrate having a surface to support the probes;
providing deposit elements constructed and arranged to deposit the probes on the surface;
aligning the deposit elements around a first axis perpendicular to the surface and around second and third axes parallel to the surface; and
depositing the probes on the surface after the deposit elements have been aligned.
- [c2] 2. The method of claim 1 , wherein:
the probes include oligonucleotides, polynucleotides, peptides, or complex proteins.
- [c3] 3. The method of claim 1 , wherein:
the second and third axes are perpendicular to each other.
- [c4] 4. The method of claim 1 , wherein:
the deposit elements include pins, quills, or jetting elements.
- [c5] 5. An apparatus, comprising:
a plurality of deposit elements constructed and arranged to deposit biological materials on a depositing surface; —
a first mounting assembly constructed and arranged to enable movement of the deposit elements around a first axis perpendicular to the depositing surface;
a second mounting assembly constructed and arranged to enable movement of the deposit elements around a second axis parallel to the depositing surface;
and
a third mounting assembly constructed and arranged to enable movement of the deposit elements around a third axis parallel to the depositing surface.
- [c6] 6. The apparatus of claim 5 , wherein:
the deposit elements include pins, quills, or jetting elements.
- [c7] 7. The apparatus of claim 5 , wherein:

the second and third axes are perpendicular to each other.

- [c8] 8. The apparatus of claim 5 , wherein:
the first mounting assembly is movable independently of one or both of the second and third mounting assemblies such that movement around the first axis is uncoupled from movement around one or both of the second and third axes, respectively.
- [c9] 9. The apparatus of claim 5 , wherein:
the second mounting assembly is movable independently of one or both of the first and third mounting assemblies such that movement around the second axis is uncoupled from movement around one or both of the first and third axes, respectively.
- [c10] 10. The apparatus of claim 5 , wherein:
the depositing surface is a surface of a substrate; and
the apparatus further comprises a holding element constructed and arranged to hold the substrate.
- [c11] 11. The apparatus of claim 10 , wherein:
the depositing surface is substantially flat.
- [c12] 12. The apparatus of claim 10 , wherein:
the substrate includes a second substantially flat surface parallel and opposed to the depositing surface; and
the holding element includes a platen having a substantially flat surface constructed and arranged to conformingly receive the second surface of the substrate.
- [c13] 13. The apparatus of claim 12 , wherein:
the substrate includes a microscope slide.
- [c14] 14. The apparatus of claim 5 , further comprising:
one or more reference planes constructed and arranged for registering the deposit elements.
- [c15] 15. The apparatus of claim 14 , wherein:

the depositing surface includes a top surface of a microscope slide; and
the one or more reference planes includes a yaw reference plane parallel to an
edge of the microscope slide.

[c16] 16. The apparatus of claim 5 , further comprising:
one or more securing elements constructed and arranged to secure the deposit
elements at a first position with respect to movement around the first axis, a
second position with respect to movement around the second axis, and a third
position with respect to movement around the third axis.

[c17] 17. The apparatus of claim 16 , wherein:
the first, second, and third positions are determined so that biological materials
are deposited from each of the deposit elements at substantially a ninety degree
angle to the depositing surface.

[c18] 18. The apparatus of claim 5 , wherein:
the first mounting assembly includes one or more bearing surfaces concentric
with the first axis.

[c19] 19. The apparatus of claim 18 , further comprising:
a gantry; and wherein
the first mounting assembly further includes a print head mount constructed
and arranged to mount the first mounting assembly to the gantry, and a head
mounting plate coupled to the deposit elements and including the one or more
bearing surfaces.

[c20] 20. The apparatus of claim 5 , wherein:
the first mounting assembly provides yaw adjustment using two or more
reference surfaces.

[c21] 21. The apparatus of claim 20 , wherein:
the yaw adjustment includes rotating the depositing elements about the first
axis without additional translation in a plane parallel to the depositing surface.

[c22] 22. An apparatus, comprising:
a first mounting assembly constructed and arranged to enable movement of

biological deposit elements around a first axis;
a second mounting assembly constructed and arranged to enable movement of the biological deposit elements around a second axis different from the first axis; and
a third mounting assembly constructed and arranged to enable movement of the biological deposit elements around a third axis different from the first and second axes.

- [c23] 23. A method, comprising the steps of:
enabling movement of biological deposit elements around a first axis perpendicular to a depositing surface;
enabling movement of the biological deposit elements around a second axis parallel to the depositing surface; and
enabling movement of the biological deposit elements around a third axis parallel to the depositing surface.
- [c24] 24. The method of claim 23 , wherein:
the deposit elements include pins, quills, or jetting elements.
- [c25] 25. The method of claim 23 , wherein:
the second and third axes are perpendicular to each other.
- [c26] 26. The method of claim 23 , wherein:
each of the enabling movement steps is uncoupled from each of the others.
- [c27] 27. A system for generating spotted probe arrays, comprising:
(1) an arrayer including
(a) a plurality of deposit elements constructed and arranged to deposit biological materials on a depositing surface,
(b) a first mounting assembly constructed and arranged to enable movement of the deposit elements around a first axis perpendicular to the depositing surface,
(c) a second mounting assembly constructed and arranged to enable movement of the deposit elements around a second axis parallel to the depositing surface,
and
(d) a third mounting assembly constructed and arranged to enable movement of

the deposit elements around a third axis parallel to the depositing surface; and
(2) a computer including a processor and a memory unit having stored therein a set of arrayer control instructions that, when executed in cooperation with the processor, controls one or more operations of the arrayer.

[c28] 28. The system of claim 27, wherein:
the one or more operations include automatically moving the deposit elements around one or more of the first, second, or third axes.

[c29] 29. The system of claim 27, wherein:
the automatic movement is responsive to a user command.

[c30] 30. A method for registering a print head with respect to a surface, comprising the steps of:
(1) moving the print head in a yaw direction so that it is aligned with respect to a yaw reference;
(2) moving the print head in a roll direction so that it is aligned with respect to a roll reference; and
(3) moving the print head in a pitch direction so that it is aligned with respect to a pitch reference; wherein the print head is constructed and arranged to deposit biological materials on the surface.

[c31] 31. The method of claim 30, further comprising the steps of:
(4) after step (1), securing the print head in the aligned yaw direction;
(5) after step (2), securing the print head in the aligned roll direction; and
(6) after step (3), securing the print head in the aligned pitch direction.

[c32] 32. An apparatus for registering deposit elements with respect to a surface of a substrate, comprising:
a first mounting assembly coupled to the deposit elements constructed and arranged to rotate the deposit elements around a first axis perpendicular to the surface;
a second mounting assembly coupled to the deposit elements constructed and arranged to rotate the deposit elements around a second axis parallel to the surface; and

a third mounting assembly coupled to the deposit elements constructed and arranged to rotate the deposit elements around a third axis parallel to the surface and perpendicular to the second axis.

[c33]

33. A method for registering deposit elements with respect to a surface of a substrate, comprising the steps of:
rotating the deposit elements around a first axis perpendicular to the surface;
rotating the deposit elements around a second axis parallel to the surface; and
rotating the deposit elements around a third axis parallel to the surface and perpendicular to the second axis.

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